of the study and is a feature to be greatly commended.

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SPECIAL ARTICLES

PROGRESSIVE VARIATION IN DECAPTERUS, A GENUS OF CARANGOID FISHES

IN the fishes of the genus *Decapterus* which the writer has examined here and abroad, six forms are recognizable, making a series from species which perhaps belong rather to *Caranx,* to the most extreme *Decapterus.* Typical *Decapterus* departs from the *Caranx* type in being less deep, less compressed, in having the last ray of the dorsal and anal fins separate from the rest of the fin, forming a mackerel-like finlet, and in possessing a bluntly pointed protuberance with a groove beside it, on the shoulder girdle under the edge of the gill cover, suggesting a not dissimilar structure in *Trachurops,* but less pronounced. The most *Caranx*-like of the six is *Decapterus affinis* of the Pacific and Indian Oceans. The four middle forms are intermediates between this and the least *Caranx*-like, *D. macarellus.* This progressive variation is readily explicable by a very attractive theory of variation with migration, submitted for what it is worth.

The six forms are:

1. *D. affinis* (Rüppel). Figured by Day ("Fauna British India, Fishes") and Jordan and Seale ("Fishes of Samoa," *D. lundini*). Specimens have been examined in the British Museum.

Depth 3.5 in length to fork of caudal. Anal soft rays 20–22. Lateral line with 50–53 scales followed by 42–47 scutes. Last ray of dorsal and anal not detached from the rest of the fin. Teeth small, evident.

Range—Pacific and Indian Oceans.

2. *D. rhonchus* (G. St.H.). A specimen examined in the Paris Museum.

Depth 4.0. Anal soft rays 25–27. 56 scales followed by 23–26 scutes in the lateral line. Last ray of dorsal and anal not detached. Teeth small, evident. Without the peculiar shoulder structure mentioned above.

Range—north and west coasts of Africa.

3. *D. maru-adsi* (Temminck & Schlegel). A specimen examined in the Paris Museum. Cat. Fish, Brit. Mus. II.

Depth 4.5. Anal rays 28. 50 scales followed by 36 scutes in lateral line. Last rays dorsal and anal detached from the remainder of the fin. Teeth minute, evident. With the peculiar shoulder structure.

Range—Japan and China coasts.

4. *D. kurra* (Cuv. & Val.). Day, Fauna British India, Fishes. The type of *D. kiliche,* C. & V., examined in the Paris Museum.

Depth 5.0. Anal rays 26. 47–55 scales followed by 33 scutes in lateral line. Last rays dorsal and anal detached. Teeth minute, evident. Peculiar shoulder structure present.

Range—Indian Ocean.

5. *D. punctatus* (Ag.). Specimens examined in the Paris Museum labelled *D. punctatus* and *D. kurroides.* Bull. 47, U. S. National Museum.

Depth 5.0. Anal rays 25. 56 scales followed by 32 scutes. Last dorsal and anal rays detached. Teeth minute, evident. Peculiar shoulder structure present.

Range—Atlantic Ocean.

6. *D. macarellus* (Cuv. & Val.). Types of *D. macarellus, pinnulatus, jacobæus* and *scombrinus,* examined in the Paris Museum. *D. macarellus* and *D. sanctæ-helenæ,* Bull. 47, U. S. National Museum.

Depth 5.5–6.0. Anal rays 28–31. 94–96 scales followed by 28–30 scutes. Last dorsal and anal rays detached. Teeth not evident. Peculiar shoulder structure present.

Range—Atlantic and Pacific Oceans.

Nos. 1 and 2 of this series would perhaps fit better in *Caranx* than in *Decapterus* (being more or less intermediate between *C. djedaba* and the genus *Decapterus*). Specimens of *rhonchus* and *maru-adsi* placed side by side resembled one another very much, the most noticeable differences being the imperfectly separated last dorsal and anal rays, and absence of shoulder peculiarity in *rhonchus. Punctatus* is much less compressed than *maru-adsi,* and *kurra* intermediate between these two as is its range. These three

are the most closely related forms. Between *punctatus* and *macarellus* is a sharp break.

An explanation of the distribution of the forms is that *affinis* spread from the Indian Ocean westward around the world. The form differentiated in the Atlantic was *rhonchus* and in the Pacific *maru-adsi,* species whose range has since been restricted to Africa and Japan and China, but still the westward migration continued, *maru-adsi* migrated into the Indian where it became *kurra,* separated by intermediate stages from the *affinis,* which had been there since the beginning and still pushing westward became *punctatus* in the Atlantic and *macarellus* in the Pacific.

With this theory as a view-point the thing that immediately calls for explanation is the relation to one another of the two final forms *punctatus* and *macarellus,* and of their ranges. The forms are so strongly differentiated as to presuppose long separation by a barrier as of land, yet they are the only adjoining members of the series occurring in the same waters, as they do in the Atlantic. A land connection from Africa to South America would obviate this difficulty as the two forms would at once have invaded one another's Atlantic ranges when this barrier was removed. Also we must explain the peculiar range of *macarellus,* found in Atlantic and Pacific, but not in the Indian, which may be readily done by supposing that the North and South American land connection is of recent origin.

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The Effect of the Club Root Disease upon the Ash Constituent of the Cabbage Root: HOWARD S. REED.

The ash analysis of healthy and diseased cabbage roots reveals appreciable variations in the amounts of certain constituents while others vary but slightly. In the diseased roots there was an appreciable increase in the amounts of calcium, magnesium, phosphoric acid, potassium and sulphuric acid, *i. e.,* an increase in the amount of "essential" elements.

The greatest increase of any single constituent was in the case of potassium. The increase of potassium appears to be coupled with an increase of protoplasmic substance and accumulation of starch.

The proportion of calcium to magnesium is greater in the diseased roots. The same is also true of the proportion of potassium to sodium, but there is no material difference in the proportion of magnesium to phosphorus. The differences in the amounts and proportion of ash constituents appear sufficiently well marked to indicate a more or less definite correlation in the metabolism both of healthy and of diseased plants.

Effect of Frost on the Aromatic Constituents of the Peppermint Plant: FRANK RABAK.

The Volatile Leaf-oil of the Washington Cedar, Thuja plicata: ROBERT E. ROSE and CARL LIVINGSTONE.

Absorption and Excretion of Salts by Roots, as Influenced by Concentration and Composition of Culture Solutions: I., Concentration Relations of Dilute Solutions of Calcium and Magnesium Nitrates to Pea Roots: R. H. TRUE and H. H. BARTLETT.

Creatinine in Plants and in the Medium in which they Grow: M. X. SULLIVAN.

The Effect of Temperature on the Respiration of Fruits: H. C. GORE.

The Phosphorus Assimilation of Aspergillus niger: ARTHUR W. DOX.

(From the Chemical Section of the Iowa Agricultural Experiment Station.)

The necessity for some form of phosphorus in culture media for lower fungi has long been recognized. Notwithstanding the variety of phosphorus compounds occurring in nature, very few have been tested with regard to their availability as sources of this element for mold cultures. Among the substances tested in this experiment were phytin, sodium glycerinophosphate, sodium nucleinate, lecithin, casein, ovovitellin, ortho-, pyro- and metaphosphates, hypophosphites and phosphites. All but the last two, which contain trivalent phosphorus, were readily utilized.

Fermentation and Putrefaction: ARTHUR I. KENDALL.

(From the Department of Preventive Medicine and Hygiene, Harvard Medical School.)

As shown by the work of the author and others, utilizable carbohydrates protect nitrogen from attack by bacteria. This finds its analogue in the metabolism of higher forms. Fermentation takes precedence over putrefaction. For the purposes of this paper, by fermentation is meant the